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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/656,182	09/08/2003	Allen McTeer	M4065.0248/P248-C	8422
24998	7590	07/14/2005	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			LEE, EUGENE	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2815	

DATE MAILED: 07/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/656,182

Applicant(s)

MCTEER, ALLEN

Examiner

Eugene Lee

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 20 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 74-80,82 and 83 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 74-80,82 and 83 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 01 December 2004 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION***Drawings***

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the said copper layer containing a **copper oxide layer** thereon; and a titanium-aluminum-copper nitrogen layer formed over at least an upper surface portion of said copper layer (claim 79) must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

FIG. 8 shows a copper oxide layer; however, it does not show the titanium-aluminum-copper-nitrogen layer formed over at least an upper surface portion of said copper layer **and** the copper oxide layer.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the

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applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claims 74 thru 78 are rejected under 35 U.S.C. 103(a) as being unpatentable over Harada et al. 5,565,378 in view of Hsiao et al. 5,985,765. Harada discloses (see, for example, FIG. 1, and FIG. 3) a bonding pad part comprising a first insulating film (dielectric layer) 75, substrate 71, DRAM element (semiconductor device) 73, barrier metal film (barrier layer) 105, bonding pad (copper layer) 89, and buffer coat film (insulating layer) 81. In column 6, lines 54-60, Harada discloses the aluminum alloy film 107, which the bonding pad is made from, may comprise copper, and titanium. Harada does not disclose said copper layer having a thickness of about 500 Angstroms to about 20,000 Angstroms. However, Hsiao discloses (see, for example, FIG. 6) a bonding pad comprising a layer (copper layer) 18B. In column 5, lines 6-7, Hsiao discloses the layer having a thickness between 6000 and 10000 Angstroms (500 Angstroms to about 20,000 Angstroms). The thickness provides adequate thickness for applying an external connection to a bonding pad. Therefore, it would have been obvious one of ordinary skill in the art at the time of invention to have said copper layer having a thickness of about 500 Angstroms to about 20,000 Angstroms because it was well within the skills of an

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artisan to optimize the performance of a semiconductor device by adjusting the thickness of the bonding pad in order to have an adequate surface so that a reliable external connection can be made to the bonding pad. See *In re Aller*, 105 USPQ 233.

Regarding claim 75, Harada in view of Hsiao does not disclose said upper surface of said copper layer implanted with titanium having a thickness of about 50 Angstroms to about 200 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of said upper surface of copper layer implanted with titanium in order to adequately add titanium to the bonding pad, which enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said upper surface of said copper layer implanted with titanium having a thickness of about 50 Angstroms to about 200 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of said upper surface of said copper layer implanted with titanium in order to add titanium to the bonding pad for enhancing the resistance to electromigration. See *In re Aller*, 105 USPQ 233.

Regarding claim 76, see, for example, FIG. 1 wherein Harada discloses a surface protecting film (passivation layer) 79. In column 6, line 65, Harada discloses the surface protecting film comprising silicon oxide.

Regarding claim 77, see, for example, FIG. 5 wherein Harada discloses an opening (via) 115 exposing a main surface (portion) 111 of a bonding pad 89.

Regarding claim 78, see, for example, column 6, lines 44-46, wherein Harada discloses the first insulating film 75 comprising silicon oxide.

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4. Claims 79, 80, and 82, and 83 are rejected under 35 U.S.C. 103(a) as being unpatentable over Jang et al. 6,423,625 B1 in view of Harada et al. 5,565,378 in view of Mahulikar et al. 5,320,689. Jang discloses (see, for example, FIG. 10) an interconnect structure comprising a copper bonding pad (conductive bond pad) 82, and an AlCu layer 102. In column 3, lines 42-45, Jang discloses the pad has a thin Cu oxide layer. Jang does not disclose the titanium of the titanium-aluminum-copper nitrogen layer. However, Harada discloses (see, for example, column 6, lines 54-61) an aluminum alloy film, which may have titanium added. The metal element enhances the resistance to electromigration. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the titanium of the titanium-aluminum-copper nitrogen layer in order to enhance the resistance to electromigration.

Jang in view of Harada does not disclose nitrogen of the titanium-aluminum-copper nitrogen layer. However, Mahulikar discloses (see, for example, abstract) a composite copper alloy wherein the copper alloy is formed with nitrogen. The copper alloy has improved tribological and mechanical properties while maintaining useful electrical conductivity. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention to have the nitrogen of the titanium-aluminum-copper nitrogen layer in order to improve tribological and mechanical properties while maintaining useful electrical conductivity.

Regarding claim 82, Jang in view of Harada in view of Mahulikar does not disclose said copper oxide layer having a thickness not greater than 300 Angstroms. However, it was well within the skills of an artisan in the art to optimize the performance of a semiconductor device by adjusting the thickness of a copper oxide layer in order to

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adequately protect an underlying layer. Therefore, it would have been obvious to one of ordinary skill in the art at the time of invention was made to have said copper oxide layer having a thickness not greater than 300 Angstroms because it was well within the skills of an artisan to optimize the performance of a semiconductor device by adjusting the thickness of a copper layer in order to adequately protect an underlying layer. See *In re Aller*, 105 USPQ 233.

Regarding claim 83, see, for example, column 3, lines 49-57 wherein Jang discloses an Au/Al ball (electrical conductor).

Response to Arguments

5. Applicant's arguments with respect to claims 74-80, 82, and 83 have been considered but are moot in view of the new ground(s) of rejection.

INFORMATION ON HOW TO CONTACT THE USPTO

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Eugene Lee whose telephone number is 571-272-1733.

The examiner can normally be reached on M-F 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Tom Thomas can be reached on 571-272-1664. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Eugene Lee
June 24, 2005

A handwritten signature in black ink, appearing to be 'Eugene Lee', with a stylized, flowing script.